PCT/GB 2004 / 0 0 5 4 2 9

The Patent Office

INVESTOR IN PEOPLE

The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.

Signed William Morell

Dated 14 January 2005

tents Form 1/77

[illegible]ts Act 1977

.e 16)

The Patent Office

1/77

THE PATENT OFFICE
C

24 DEC 2003

NEWPORT

28DEC03 E862077-7 D00291
P01/7700 0.00-0329983.1 CHEQUE

The Patent Office

Cardiff Road
Newport
Gwent NP9 1RH

equest for grant of a patent

: the notes on the back of this form. You can also get xplanatory leaflet from the Patent Office to help you fill in form)

Your reference	DCS/P02127UK	24 DEC 2003
Patent application number *(The Patent Office will fill in this part)*	0329983.1	
Full name, address and postcode of the or of each applicant *(underline all surnames)*	Surface Generation Limited 8 Orton Enterprise Centre Bakewell Road, Orton Southgate Peterborough, PE2 6XU	
Patents ADP number *(if you know it)*		8779183001
If the applicant is a corporate body, give the country/state of its incorporation	England	
Title of the invention	Improved Tooling System	
Name of your agent *(if you have one)*	**Marks & Clerk**	
"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*	**144 New Walk** **Leicester** **LE1 7JA**	
Patents ADP number *(if you know it)*	~~**711002**~~ 869116400 ! .	

If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or each of these earlier applications and *(if you know it)* the or each application number	Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

If this application is divided or otherwise derived from an earlier UK application, give the number and filing date of the earlier application	Number of earlier application	Date of filing *(day / month / year)*

Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'yes' if:* *a) any applicant named in part 3 is not an inventor, or* *b) there is an inventor who is not named as an applicant, or* *c) any named applicant is a corporate body.*	yes

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	
Description	7
Claim*(s)*	2
Abstract	
Drawing*(s)*	4 + 4 RM

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translation of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	1
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature Diana C Stagg

Date 23.12.03

12. Name and daytime telephone number of person to contact in the United Kingdom

Diana C Stagg
(0116) 233 8181

/arning

fter an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or ɔmmunication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is ɛcessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents ɛt 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an ɔplication has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no 'rection prohibiting publication or communication has been given, or any such direction has been revoked.

Title: Improved Tooling System

The present invention relates to an improved component for use in a tooling system, and to an improved tooling system including this component.

The improved component is particularly suitable for use in the tooling systems described and claimed in International Patent Application No. WO 02/064308.

This patent application describes and claims a tooling system comprising a plurality of elements arranged in an array, each element being moveable longitudinally relative to the other elements in the array and having a first end, the system further comprising means to adjust the relative longitudinal positions of the elements such that the free ends of the elements define approximately a desired surface contour and means for retaining the elements in their adjusted positions, characterised in that: the first end of each element is provided on a machinable portion removably mounted to a base portion, the arrangement being such that the free ends of the elements can be machined to produce the desired surface contour.

This patent application further describes and claims a tooling system comprising a plurality of elements arranged in an array, the elements of the array being movable between a closed position in which the elements contact one another and are secured in position, and an open position in which the elements of the array are spaced apart and are capable of vertical movement relative to one another, and drive means for opening and closing the array. The elements are mounted on support rails to form the array.

In International Patent Application No. WO 02/064308, it is taught that the tooling system comprises means to adjust the relative longitudinal positions of the elements of the system.

Two alternative arrangements for adjusting the relative longitudinal positions of the elements are disclosed by way of example in International Patent Application No. WO 02/064308.

In one alternative arrangement, the elements are moved vertically relative to one another by

a drive means comprising a downwardly extending threaded rod rotatably mounted to the underside of each element and threadingly engaged in a base portion. The elements are positioned by rotation of the threaded rods, each of which is driven by an electric motor.

In a second alternative arrangement, all of the elements are lifted manually and each element is allowed to fall under gravity to a desired position, when the element is secured.

It is an object of the present invention to provide a further alternative arrangement for moving the elements of an array of this type relative to one another, in order to increase the choice and options available to a user of the system.

It is a further object of the present invention to provide a component for use in this arrangement.

The present invention provides a tooling system which comprises a plurality of elements arranged in an array, each element being supported on a cross rail and being moveable relative to the other elements in the array, characterised in that each element terminates in a threaded support post extending from a first end of the element, and is associated with a corresponding internally threaded aperture in the cross rail upon which the element is supported, and in that the tooling system further comprises an adjusting component driveable in rotation and engageable with an element of the array to drive the element in rotation, upon rotation of the adjusting component.

The radius described by rotation of the adjusting component is preferably less than or equal to the radius of rotation of an element in the array.

In a preferred embodiment of the tooling system according to the invention, the adjusting component comprises a fork, more preferably a fork comprising a substantially square head portion, from each of the four corners of which square head depends a tine, the tines defining a gripping area corresponding to the area of an element of the array.

In a particularly preferred embodiment, the tooling system according to the invention, the adjusting component comprises an adjustable fork, the tines of which depend from a head portion, the position of which tines can be adjusted relative to each other to define a plurality

of differently sized adjustment areas.

The present invention further provides an adjusting component for use in a tooling system of the type described above, which adjusting component comprises a fork having a head portion, and a plurality of spaced tines depending from the head portion, each of which tines comprises a first section adjacent to the head portion and having an inwardly facing surface which together with the inwardly facing surfaces of the other tines defines an adjustment area and a second section remote from the head portion and having an inwardly facing guide surface.

The adjusting component preferably comprises a fork having a square head portion, from each of the four corners of which depends a tine, each of the four tines comprising a first portion which is substantially triangular in cross-section, leading to a second portion, the inwardly facing surface of which tapers towards the free end of the tine.

The inwardly facing guide surface of the second section of the tine is preferably convex.

At the surface of the head portion from which the tines depend, the inwardly facing surfaces of the first sections of the tines define an adjustment area, the dimensions of which preferably correspond to the dimensions of the associated element of the array.

The first and second sections of the tine each preferably extends along the length of the tine to a distance which is greater than the maximum height variation in the machined surface of an element.

In a preferred embodiment of the fork according to the invention, the square head portion is adjustable in size, so that the tines can be moved relative to one another to define a plurality of differently sized adjustment areas, corresponding to differently sized elements.

The tines of the adjusting component are preferably further adapted to engage with an element of the array in gripping engagement, in order to enable the adjusting component to lift the element after it has been rotated free of the support rail. Where the adjusting component is itself adjustable, this gripping engagement may be effected by moving the tines

away from the element and then pivoting them into engagement therewith. Alternatively, the tines may be formed with expandable faces.

The adjusting component according to the invention preferably further comprises one or more sensors, for detecting the position of and measuring the force applied to an element of the array.

In a particularly preferred embodiment of the adjusting component according to the invention, mass is added to the adjusting component in order to increase its driving force.

The adjusting component according to the invention is adapted to receive in driving engagement, a driving means for driving the adjusting component in rotation.

An embodiment of an adjusting component and a tooling system according to the invention will now be described with reference to the accompanying drawings, in which

Figure 1 is a view of a machine layout;

Figure 2 is a side view of an adjusting component;

Figure 3 is a perspective view of the adjusting component of Figure 2;

Figure 4 is a view of the adjusting component of Figures 2 and 3 in driving engagement, with an element of the array of Figure 1;

Figure 5 is a view of an alternative embodiment of an adjusting component, the size of which can be adjusted and

Figure 6 is a view of the adjusting component of Figure 5, adjusted for gripping an element of the array.

As can be seen from Figure 1, a tooling system shown generally at 10 comprises a support table 2 on which is located a bridge 4, comprising a horizontal span 6 supported by first and

second vertical supports 8,12. The horizontal span 6 supports an adjustment mechanism 14 and a machining tool 16.

The system 10 further comprises a consumable module 20 comprising array elements 24 supported on cross rails 22, which are themselves supported on a chassis (not shown) on the support table 2.

Each of the elements 24 terminates in a threaded support post 25 which engages with an internally threaded aperture (not shown) in the cross rail 22.

First and second side arms 26, 28 extend from the first and second vertical supports 8, 12 respectively, and terminate in retractable pegs 30, 32 adapted to engage with recesses in the ends of the cross rails 22.

The elements 24 are arranged in an array, as shown in Figure 5 and are held in place by four bolsters, two of which are shown at 34 and 36.

The machining tool shown generally at 16 comprises a spindle 42 and a tool head 44 mounted on the spindle 42.

The tool further comprises drive means (not shown) for locating and driving the tool head 44 via the spindle 42.

The adjusting mechanism shown generally at 14 comprises an adjustment fork 46 mounted on a spline and a hydraulic cylinder 48 and provided with a rotating drive (not shown).

The adjustment fork 46 comprises a square head portion 49 from which depend four tines 50, 52, 54 and 56, one tine depending from each of the four corners of the square head portion 49.

As can be seen from Figures 2, 3 and 4, each of the tines 50, 52, 54 and 56 comprise a first portion 58 which is substantially triangular in cross-section and which terminates in a tapered portion 60.

The tapered portion 60 provides an inwardly facing guide surface for the element 24. This inwardly facing guide surface has a convex profile.

In use, a target row of array elements 24 is selected and the consumable module 20 is driven, either manually or using a drive system, so that the target row is located parallel to the longitudinal axis of the bridge 4.

A section of the array including a row adjacent to the target row, and all of the rows of the array on the other side of that adjacent row, is separated from the target row, by first driving the bridge 4 into alignment with the adjacent row and then engaging the pegs 30, 32 in the recesses provided in the ends of the cross rail 22 supporting the adjacent row. The bridge 4 can then be used to separate the section from the target row.

The pegs 30, 32 are then retracted from the recesses in the cross rail 22 and the bridge 4 is then driven into alignment with the target row, and the pegs 30, 32 engaged in the recesses of the cross rail 22 supporting the target row. The target row can then be separated from the remaining adjacent row so that the elements of that row can be accessed.

An element within the target row is then selected. The adjustment mechanism 14 is then driven along the bridge 4 so that it is aligned vertically with a first element adjacent to the selected target element. The pressure in the hydraulic cylinder 48 is released and the fork 46 is allowed to fall under its own weight, so that the tines 50, 52, 54, 56 engage the head of the array element 24 in rotary driving engagement. As the fork 46 falls under its own weight, the guide surfaces of the tapered portions 60 operate to correct any misalignment of the array element 24 by rotating it. The adjustment fork 46 is then driven in rotation through 45° and the process is repeated with the second adjacent element.

The adjustment mechanism 14 is then aligned with the selected target element and allowed to engage the target element in a similar manner.

The adjustment fork 46 is then driven in rotation either to raise or lower the array element 24 by rotating it about the axis of its threaded post. When the element 24 has attained the

predetermined height and correct angular orientation, the fork 46 is raised out of engagement with the element and is moved so that a next element is located beneath the adjustment fork and the adjustment process repeated until all of the array elements 24 in the line have been adjusted to their predetermined heights. Fine correction of any misalignment of array elements may be carried out by lowering the fork into the open array, and using the external surfaces of the fork to align the array elements.

The tops of the array elements can then be machined as required using the machining tool 16.

An embodiment of an adjustable adjusting component is shown in Figures 5 and 6. The adjustment sequence is shown in Figure 5, in which Figure 5(a) shows the tines defining an adjustment area corresponding to a first (smaller) element. The tines are then adjusted through an intermediate position Figure 5(b) to an extended position Figure 5(c) where the tines define an adjustment area corresponding to a second (larger) element.

The adjustable adjusting component of Figure 5 is shown in Figure 6 in gripping engagement with an element of the array. The tines have been slightly extended away from the element and pivoted to grip the element.

Claims

1. A tooling system which comprises a plurality of elements arranged in an array, each element being supported on a cross rail and being moveable relative to the other elements in the array, characterised in that each element terminates in a threaded support post extending from a first end of the element, and is associated with a corresponding internally threaded aperture in the cross rail upon which the element is supported, and in that the tooling system further comprises an adjusting component driveable in rotation and engageable with an element of the array to drive the element in rotation, upon rotation of the adjusting component.

2. A tooling system according to claim 1 characterised in that the adjusting component comprises a fork.

3. A tooling system according to claim 2 characterised in that the adjusting component comprises a fork comprising a head portion, and a plurality of spaced tines depending from the head portion, the tines defining an adjustment area corresponding to the area of an element of the array.

4. A tooling system according to claim 3 characterised in that the fork comprises a substantially square head portion, from each of the four corners of which square head depends a tine, the tines defining an adjustment area corresponding to the area of an element of the array.

5. A tooling system according to any of claims 2 to 4 characterised in that the adjusting component comprises an adjustable fork, the tines of which depend from a head portion, the position of which tines can be adjusted relative to each other to define a plurality of differently sized adjustment areas.

6. A tooling system according to any of claims 1 to 5 characterised in that the radius described by rotation of the adjusting component is preferably less than or equal to the radius of rotation of an element in the array.

7. An adjusting component for use in a tooling system according to any of claims 1 to 5 which adjusting component comprises a fork having a head portion, and a plurality of spaced tines depending from the head portion, each of which tines comprises a first section adjacent to the head portion and having an inwardly facing surface which together with the inwardly facing surfaces of the other tines defines an adjustment area and a second section remote from the head portion and having an inwardly facing guide surface.

8. An adjusting component according to claim 7 characterised in that the inwardly facing guide surface of the second section of the tine is convex.

9. An adjusting component to claim 7 or claim 8 which adjusting component comprises a fork having a square head portion, from each of the four corners of which depends a tine, each of the four tines comprising a first section which is substantially triangular in cross-section, leading to a second section, the inwardly facing surface of which tapers towards the free end of the tine.

10. An adjusting component as claimed in claim 9 in which the square head portion is adjustable in size, so that the tines can be moved relative to one another to define a plurality of differently sized adjustment areas, corresponding to differently sized elements.

11. An adjusting component according to any of claims 6 to 10, which adjusting component further comprises one or more sensors, for detecting the position of and measuring the force applied to an element of the array.

12. A tooling system substantially as herein described and with reference to the accompanying drawings.

13. An adjusting component substantially as herein described and with reference to the accompanying drawings.

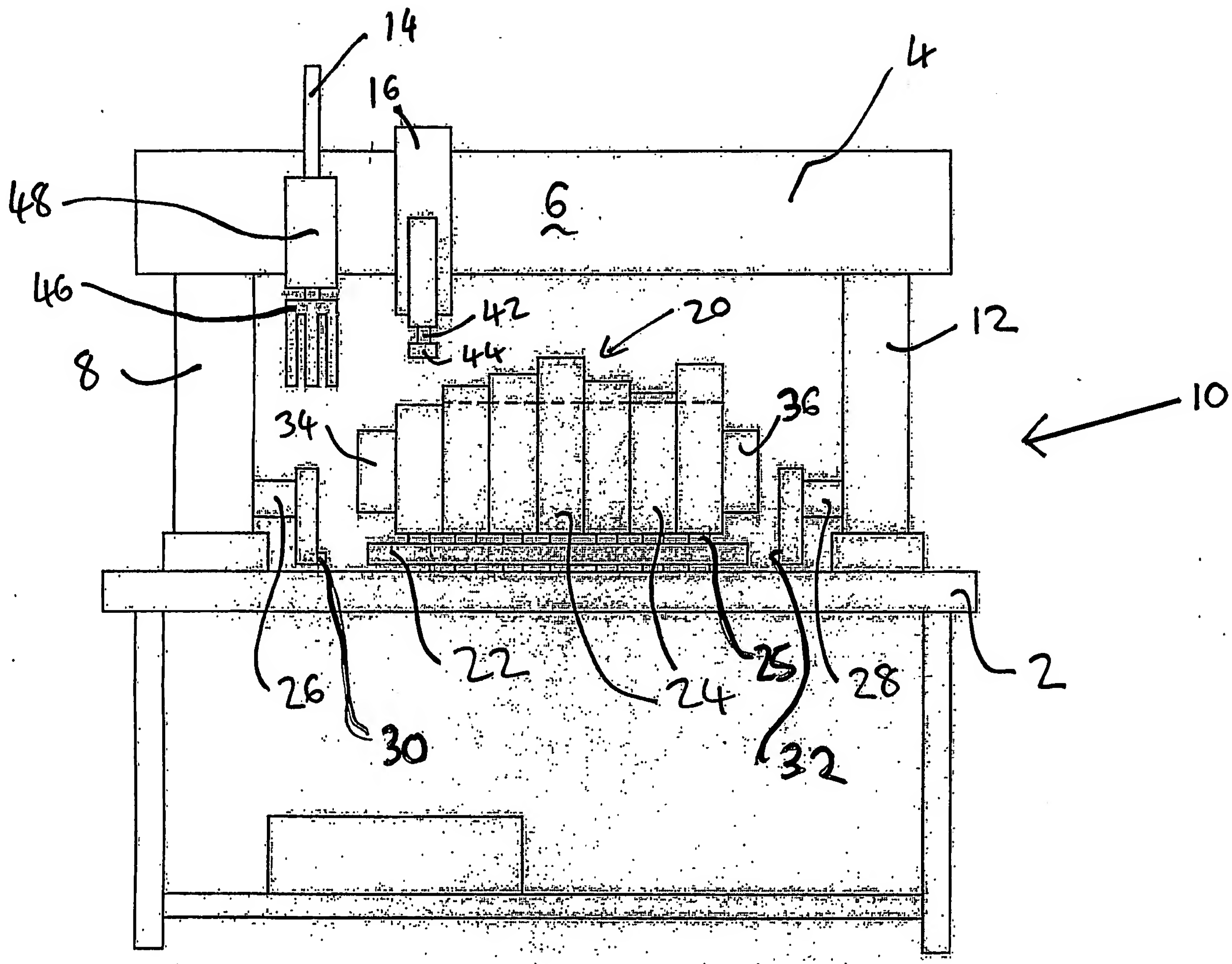


Figure 1

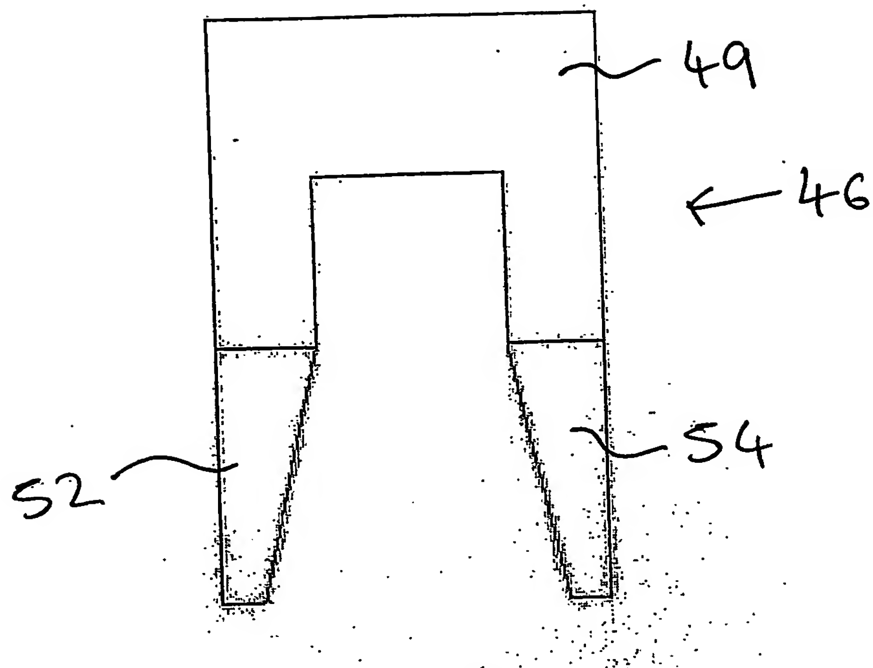


Figure 2

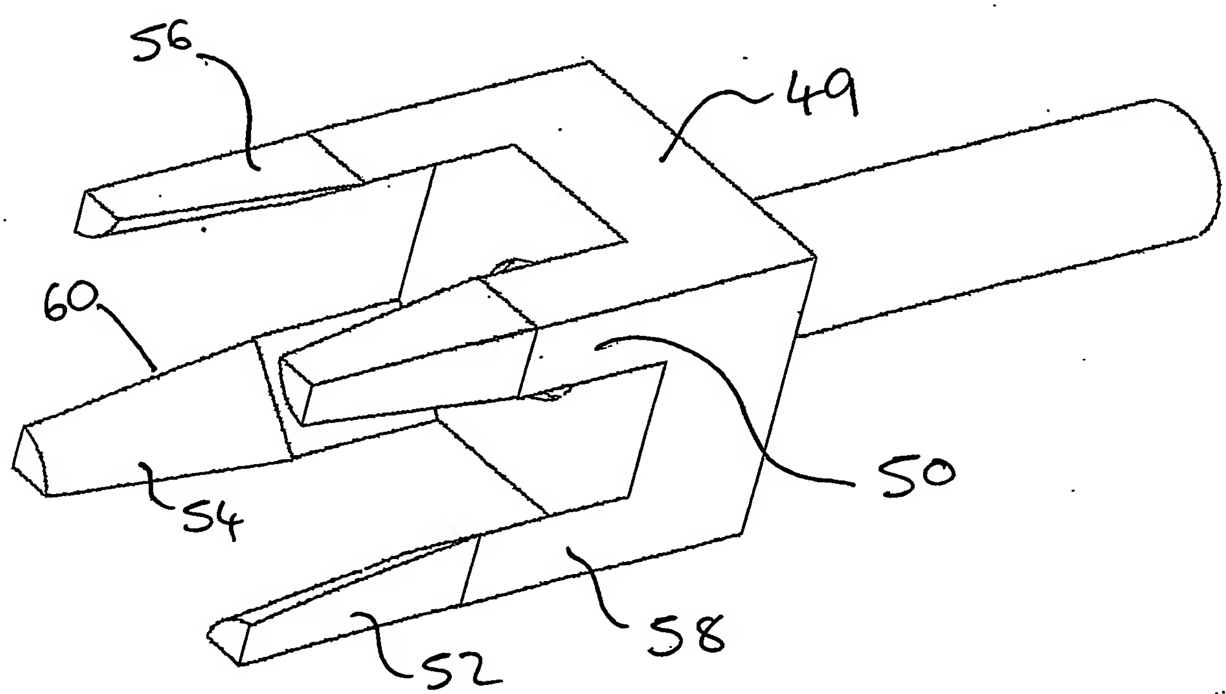


Figure 3

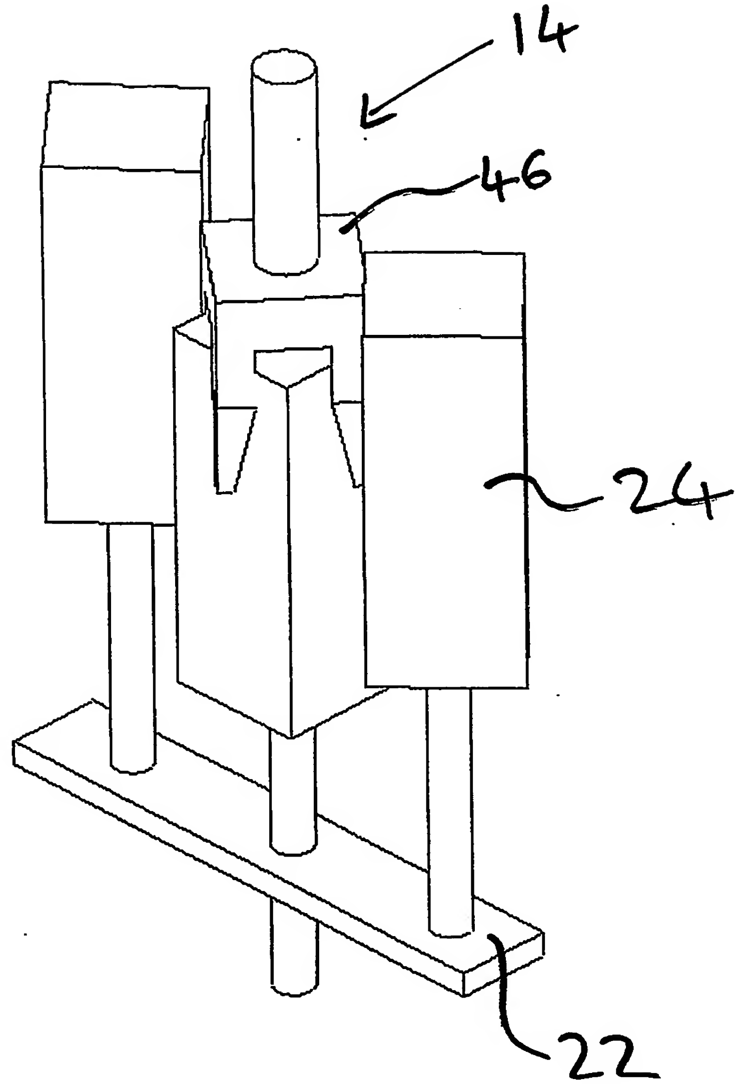


Figure 4

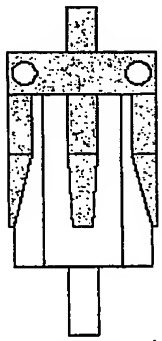


Figure 5(a)

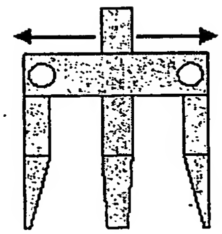


Figure 5(b)

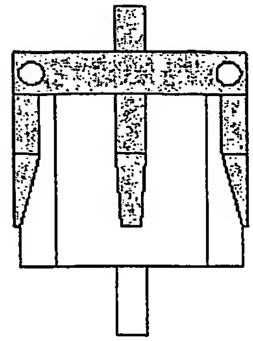
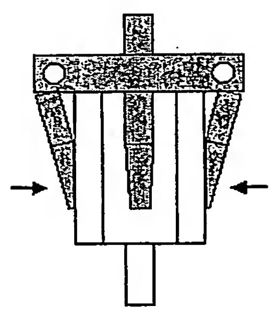


Figure 5(c)

Figure 6



Document made available under the Patent Cooperation Treaty (PCT)

International application number: PCT/GB04/005429

International filing date: 23 December 2004 (23.12.2004)

Document type: Certified copy of priority document

Document details: Country/Office: GB
Number: 0329983.1
Filing date: 24 December 2003 (24.12.2003)

Date of receipt at the International Bureau: 24 January 2005 (24.01.2005)

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b)